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EXAMINER	
PATEL, TAYAN B	
ART UNIT	**PAPER NUMBER**
1795	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/525,689	MONZYK ET AL.	
	Examiner	Art Unit	
	Tayan Patel, Esq.	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 November 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. Claims 1-3, 10-13, 16-17 & 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ayers (US 4466869) in view of O'Leary et al. (US 4080279).

With regard to claim 1, Ayers discloses a photolytic apparatus, 1, comprising a cell, 3, having an anode compartment with a photo active surface/photoelectrode, 5, of the anode, 9, and a cathode compartment with a cathode/counter electrode/catalyst layer, 51 (See column 4, lines 47-60; See also figure 1) having the ability to convert the electrolyte/water to oxygen at the anode and hydrogen at the cathode (See column 8, lines 21-23), said cathode being connected to the anode (See figure 1 - the catalyst layer/cathode is connected to the photoelectrode layer, 5, of the anode, 9); & a light

source, 61, for providing light photons to the cell and activating the surface as seen by the bubbles evolved at the surface of the photoelectrode (See column 4, lines 61-67; See also figure 1). However, Ayers fails to explicitly discuss the cathode compartment having the ability to convert carbon dioxide and hydrogen to a solid or liquid medium whereby carbon dioxide is essentially removed from the cell.

O'Leary et al. discloses an electrolytic cell comprising a catholyte volume with carbon dioxide whereby all of the carbon dioxide reacts with alkali metal hydroxide (contains hydrogen ion) in order to economically produce alkali metal carbonates directly within a cell. See column 2, lines 13-29.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the carbon dioxide conversion method in O'Leary et al. in the apparatus of Ayers in order to economically produce alkali metal carbonates directly within a cell.

With regard to claims 2-3, Ayers further discloses a photo-reactive surface comprising a light-activated catalyst comprising a Beer type catalyst of titanium oxides in an n-type semiconductor form. See column 2, lines 48-58.

With regard to claim 10, O'Leary further discloses CO2 and H2 (hydrogen gas is broken into ions during the conversion process) converted to a carbonate solid. See column 2, lines 13-29.

With regard to claim 11, Ayers further disclose a substrate, 9, that reacts with hydrogen (hydrogen is broken into ions during the conversion process) to produce a non-gaseous substance. See column 4, lines 47-60.

With regard to claim 12, Ayers further discloses a substrate that is electroconductive and made of low band gap material. Such a material is known in the art to be an electrochemically reducible compound. See column 3, lines 5-12.

With regard to claim 13, Ayers further discloses a photoreactive surface/photoelectrode, 5, having a substantially transparent electrolytic layer, 7, and an electroconductive substrate, 9. See column 4, lines 21-39.

With regard to claims 16-17, Ayers further discloses a ion permeable membrane as a cation permeable barrier, 53, that separates the anode and cathode compartments and allows the flow of hydrogen ions from the anode compartment to the cathode compartment because the hydrogen ions are produced from the electrolyte/water that originates in the anode compartment. See column 5, lines 9-14; See also figure 1.

With regard to claim 33, O'Leary further discloses CO2 and H2 (hydrogen gas is broken into ions during the conversion process) converted to an organic carbon based compound such as a carbonate solid. See column 2, lines 13-29.

8. Claims 4-7 & 14 are rejected under 103(a) as being unpatentable over Ayers (US 4466869) in view of O'Leary et al. (US 4080279) as applied to claim 1, 2 and 13 above, and further in view of Bender (US 2002/0033369).

With regard to claim 4, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 1 above, yet fails to discuss an ultraviolet light source at 350-500 nm.

Bender discloses a system for photolytic oxidation/reduction of water where a lamp emits ultraviolet radiation having a continuous range of wavelengths from between

about 185 nm to about 400 nm in order to increase UV flux. See page 4, paragraph 0051.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the light source in Bender in apparatus of modified Ayers in order to increase UV flux.

With regard to claims 5-6, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 2 above, yet fails to discuss converting water to hydrogen ions, electrons and active oxygen (hydrogen peroxide).

Bender discloses a system for photolytic oxidation/reduction of water wherein water is converted into hydrogen peroxide (active oxygen) and ozone in order to reduce the amount of additional oxidant required to neutralize and degrade organic compounds. See page 11, paragraph 0228. The electrons and hydrogen ions would inherently be formed from the above reaction.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the reaction in Bender in the apparatus of modified Ayers in order to reduce the amount of additional oxidant required to neutralize and degrade organic compounds.

With regard to claim 7, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 5 above, wherein Bender further discloses oxidation of hydroxyl radicals after a subsequent reduction step in order produce carbon dioxide, water or various intermediate species.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the subsequent oxidation step in Bender in modified Ayers in order to produce carbon dioxide, water or various intermediate species.

With regard to claim 14, Ayers further discloses light-activated catalyst comprising a Beer type catalyst of titanium oxides in an n-type semiconductor form. See column 2, lines 48-58. However, modified Ayers fails to discuss converting water to hydrogen ions, electrons and active oxygen (hydrogen peroxide).

Bender discloses a system for photolytic oxidation/reduction of water wherein water is converted into hydrogen peroxide (active oxygen) and ozone in order to reduce the amount of additional oxidant required to neutralize and degrade organic compounds. See page 11, paragraph 0228. The electrons and hydrogen ions would inherently be formed from the above reaction.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the reaction in Bender in the apparatus of modified Ayers in order to reduce the amount of additional oxidant required to neutralize and degrade organic compounds.

9. Claims 8-9 & 15 are rejected under 103(a) as being unpatentable over Ayers (US 4466869) in view of O'Leary et al. (US 4080279) in view of Bender (US 2002/0033369) as applied to claim 5 and 14 above, respectively and further in view of Fujii (US 2002/0170815).

With regard to claims 8-9 and 15, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 5 and 14 above, respectively, yet fails to

discuss a disproportionation catalyst that converts the active oxygen, *supra*, as cited in Bender, into dissolved oxygen.

Fujii discloses a method of removing gas contaminants via a photocatalyst wherein disproportionation catalysts/manganese dioxide catalysts are used in order to decompose ozone. See page 7, paragraph 0113; See also page 3, paragraphs 0037-38.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the manganese dioxide in Fujii in the apparatus of modified Ayers in order to decompose ozone.

10. Claim 18 is rejected under 103(a) as being unpatentable over Ayers (US 4466869) in view of O'Leary et al. (US 4080279) as applied to claim 1 above, and further in view of Lundquist (US 6436294).

With regard to claim 18, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 1 above, yet fails to discuss an ion exchange medium comprising a mesoporous material.

Lundquist discloses a medium that exchanges ions comprising a mesoporous material such as SAMMS in order to increase the medium's capacity to adsorb or absorb metal ions. See column 1-2, lines 55-24;

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the mesoporous material in Lundquist in the apparatus of modified Ayers in order to increase the medium's capacity to adsorb or absorb metal ions.

11. Claims 19-22, 28, 32 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ayers (US 4466869) in view of Bender (US 2002/0033369) in view of O'Leary et al. (US 4080279) in view of Bacskai (US 4101531).

With regard to claims 19 and 34, Ayers discloses a photolytic apparatus, 1, comprising a cell, 3, having an anode compartment and a cathode compartment, a) said anode compartment having an inlet (See figure 1) for receiving aqueous solution, an anode conductor/substrate, 9, with a photo active surface/photoelectrode, 5, an outlet (see figure 1) for transporting oxygenated solution of the anode compartment; (See column 4, lines 47-60; See also figure 1), b) said cathode compartment having an inlet (see figure 1), a cathode conductor, 51, and an outlet (see figure 1), wherein said cathode conductor is connected to said anode conductor (See figure 1 – the layer is in connection with the anode); & a light source, 61, for providing light photons to the cell and activating the surface as seen by the bubbles (initiated chemical reaction) evolved at the surface of the photoelectrode (See column 4, lines 61-67; See also figure 1) that results in dissolved oxygen generation at the anode compartment. However, Ayers fails to discuss converting water to hydrogen ions, electrons and active oxygen (hydrogen peroxide).

Bender discloses a system for photolytic oxidation/reduction of water wherein water is converted into hydrogen peroxide (active oxygen) and ozone in order to reduce the amount of additional oxidant required to neutralize and degrade organic compounds. See page 11, paragraph 0228. The electrons and hydrogen ions would inherently be formed from the above reaction.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the reaction in Bender in the apparatus of Ayers in order to reduce the amount of additional oxidant required to neutralize and degrade organic compounds. However, modified Ayers does not discuss receiving hydrogen ions and carbon dioxide in the cathode compartment.

O'Leary et al. discloses an electrolytic cell comprising a catholyte volume with carbon dioxide whereby all of the carbon dioxide reacts with alkali metal hydroxide (contains hydrogen) in order to economically produce alkali metal carbonates directly within a cell. See column 2, lines 13-29.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the carbon dioxide conversion method in O'Leary et al. in the apparatus of modified Ayers in order to economically produce alkali metal carbonates directly within a cell. However, modified Ayers does not disclose the addition of a catalyst and C5 pentose in order to produce C6 pentose/higher carbon compositions.

Bacskai discloses a catalyst system to remove a lactamate salt from the mixture whereby a catalyst, carbon dioxide and C5-C6 lactam are combined whereby carbon dioxide forms adducts with lactamate salts, such as C6/higher carbon composition, in order to remove C6. See column 3, lines 9-27.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the catalyst system in Bacskai in the apparatus of modified Ayers in order to remove C6.

With regard to claims 20-21, Ayers further discloses a photo-reactive surface comprising a light-activated catalyst comprising a Beer type catalyst of titanium oxides in an n-type semiconductor form. See column 2, lines 48-58.

With regard to claim 22, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 19 above, yet fails to discuss a ultraviolet light source at 350-500 nm.

Bender discloses a system for photolytic oxidation/reduction of water where a lamp emits ultraviolet radiation having a continuous range of wavelengths from between about 185 nm to about 400 nm in order to increase UV flux. See page 4, paragraph 0051.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the light source in Bender in apparatus of modified Ayers in order to increase UV flux.

With regard to claim 28, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 20 above, yet fails to discuss converting water to hydrogen ions, electrons and active oxygen (hydrogen peroxide).

Bender discloses a system for photolytic oxidation/reduction of water wherein water is converted into hydrogen peroxide (active oxygen) and ozone in order to reduce the amount of additional oxidant required to neutralize and degrade organic compounds. See page 11, paragraph 0228. The electrons and hydrogen ions would inherently be formed from the above reaction.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the reaction in Bender in the apparatus of modified Ayers in order to reduce the amount of additional oxidant required to neutralize and degrade organic compounds.

With regard to claim 32, Ayers further discloses a ion permeable membrane as a cation permeable barrier, 53, that separates the anode and cathode compartments and allows the flow of hydrogen ions from the anode compartment to the cathode compartment because the hydrogen ions are produced from the electrolyte/water that originates in the anode compartment. See column 5, lines 9-14; See also figure 1.

12. Claims 23-24, 26-27 and 29 are rejected under 103(a) as being unpatentable over Ayers (US 4466869) in view of Bender (US 2002/0033369) in view of O'Leary et al. (US 4080279) in view of Bacskai as applied to claim 19 above, and further in view of Fujii (US 2002/0170815).

With regard to claims 23 and 26-27, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 19 above, yet fails to discuss a disproportionation catalyst

Fujii discloses a method of removing gas contaminants via a photocatalyst wherein disproportionation catalysts/manganese dioxide catalysts are used in order to decompose ozone. See page 7, paragraph 0113; See also page 3, paragraphs 0037-38.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the manganese dioxide in Fujii in the apparatus of modified Ayers in order to decompose ozone.

With regard to claim 24, Ayers further discloses a photoreactive surface/photoelectrode, 5, having a substantially transparent electrolytic layer, 7, and an electroconductive substrate, 9 (See column 4, lines 21-39; See also figure 1) and a photo-reactive surface comprising a light-activated catalyst comprising a Beer type catalyst of titanium oxides in an n-type semiconductor form. See column 2, lines 48-58. Fujii further discloses a manganese dioxide catalyst. See page 7, paragraph 0113; See also page 3, paragraphs 0037-38. The combined references of Ayers and Fujii provide two layers situated within the photolytic cell of Ayers wherein two layers exist. See Ayers - figure 1.

With regard to claim 29, modified Ayers discloses all of the claimed limitations as discussed with respect to 26, respectively, yet fails to discuss a disproportionation catalyst that converts the active oxygen, *supra*, as mentioned in Bender, into dissolved oxygen.

Fujii discloses a method of removing gas contaminants via a photocatalyst wherein disproportionation catalysts/manganese dioxide catalysts are used in order to decompose ozone. See page 7, paragraph 0113; See also page 3, paragraphs 0037-38.

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the manganese dioxide in Fuji in the apparatus of modified Ayers in order to decompose ozone.

13. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ayers (US 4466869) in view of Bender (US 2002/0033369) in view of O'Leary et al. (US 4080279) in view of Bacskai (US 4101531) and further in view of Lundquist (US 6436294).

With regard to claim 25, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 19 above, yet fails to discuss an ion exchange medium comprising a mesoporous material.

Lundquist discloses a medium that exchanges ions comprising a mesoporous material such as SAMMS in order to increase the medium's capacity to adsorb or absorb metal ions. See column 1-2, lines 55-24;

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the mesoporous material in Lundquist in the apparatus of modified Ayers in order to increase the medium's capacity to adsorb or absorb metal ions.

14. Claims 30-31 are rejected under 103(a) as being unpatentable over Ayers (US 4466869) in view of Bender (US 2002/0033369) in view of O'Leary et al. (US 4080279) in view of Bacskai in view of Fujii (US 2002/0170815) as applied to claim 26 above, and further in view of Lundquist (US 6436294).

With regard to s 30-31, modified Ayers discloses all of the claimed limitations as discussed with respect to claim 26 above, yet fails to discuss an ion exchange medium comprising a mesoporous material.

Lundquist discloses a medium that exchanges ions comprising a mesoporous material constructed of self-assembled monolayers on mesoporous supports in order to increase the medium's capacity to adsorb or absorb metal ions. See column 1-2, lines 55-24;

It would have been obvious to one of ordinary skill in the art at the time the invention was claimed to use the mesoporous material in Lundquist in the apparatus of modified Ayers in order to increase the medium's capacity to adsorb or absorb metal ions.

Response to Arguments

Applicant's arguments filed 02 November 2007 have been fully considered but they are not persuasive. Applicant is requested to review Examiner's response to arguments below.

Objection

Examiner withdraws the objection to the specification in view of Applicant's amendment to the specification.

35 U.S.C. 112 Rejection/Objection

Examiner withdraws the rejection/objection as to claim 31 in view of Applicant's amendment to the claim cancelling the acronym and inputting the full phrase.

35 U.S.C. 103 Rejections

Claims 1-3

There is no motivation to combine the references because if O'Leary's cathode was connected to the anode, the apparatus would short circuit, thus, nothing would be produced.

In response, Examiner contends that O'Leary modifies Ayers to the extent that Ayers does not explicitly describe the cathode compartment having the ability to convert carbon dioxide and hydrogen to a solid or liquid medium whereby carbon dioxide is essentially removed from the cell. As such, O'Leary's cathode connection to the anode has not been introduced to modify Ayers, thus, short circuiting is not at issue.

Ayers does not appear to disclose the connection of the anode to the cathode.

In response, Ayers exhibits a connection between the anode and the cathode as depicted in figure 1. The counter electrode/cathode, 51, is a catalyst layer in connection with the anode, 9, having a photoactive surface, 5. See also column 4, lines 47-60.

Claims 4-7 & 14; 8-9 & 15; & 18

Applicant is requested to view the arguments for claims 1-3 above, *supra*.

Claims 19-32

Applicant is requested to view the arguments for claims 1-3 above, *supra*.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tayan B. Patel Esq. whose telephone number is (571) 272-9806. The examiner can normally be reached on Monday-Thursday, 7:30-5:00 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Neckel D. Alexa can be reached on (571)272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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SUPERVISORY PATENT EXAMINER